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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G08G 5/06

A1

(11) International Publication Number: **WO 98/52174**

(43) International Publication Date: 19 November 1998 (19.11.98)

(21) International Application Number: PCT/FI97/00281

(22) International Filing Date: 13 May 1997 (13.05.97)

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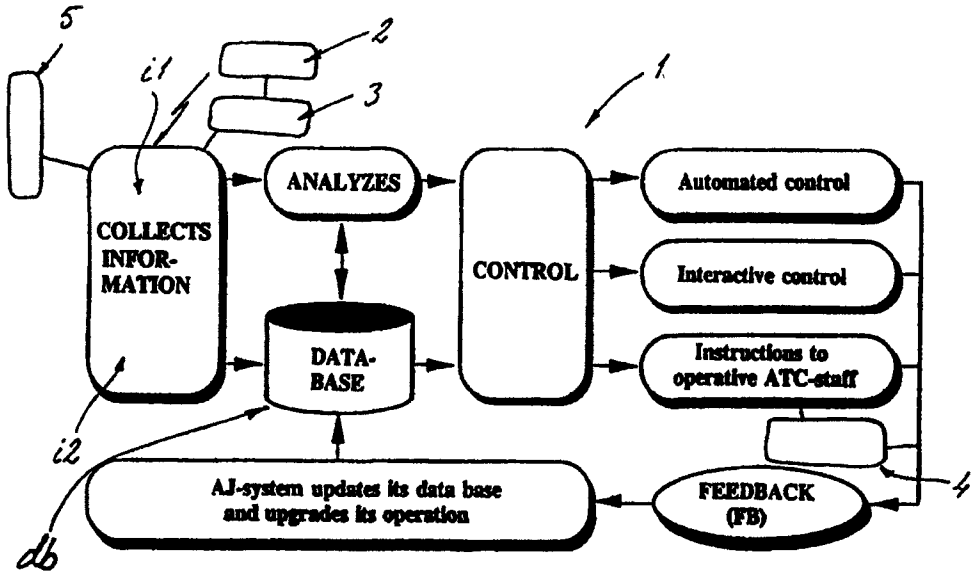
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

With international search report.

In English translation (filed in Finnish).

(54) Title: METHOD AND CONTROL SYSTEM FOR OPERATIVE TRAFFIC



(57) Abstract

The invention relates to a method for operative traffic, said traffic, such as operative ground traffic associated with air traffic, being controlled by means of a real–time and preferably so–called self–learning expert system (1), at least substantially all operative units, such as aircraft, field, maintenance, and upkeep equipment, vehicles or the like, as well as preferably also persons and groups of persons, present in an operative traffic area, being at least in an information transmitting communication therewith at least for the identification and substantially continuous positioning of the latter. The invention relates also to a control system applying the method.

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Method and control system for operative traffic

A method for operative traffic, said operative traffic, especially operative ground traffic associated with air traffic, being controlled by means of a real-time and automated data processing unit, at least some of the operative units, such as aircraft, field, maintenance, and upkeep equipment, vehicles or the like, present in an operative traffic area, being at least in an information transmitting communication therewith at least for the identification and positioning of the latter.

It is possible to apply a method of the invention in a wide variety of applications, e.g. for safely controlling operative traffic occurring on the ground, in water and/or in the air. One of the key applications for a method of the invention is the control of operative ground traffic associated especially with air traffic.

It is prior known that the ground traffic, especially one associated with air traffic, is run by using quite traditional methods and arrangements, each airport being always provided with an air traffic control tower, which is the base for controlling all airport operations involving both ground and air traffic activities by using conventional radar and monitor systems. However, the traditional control methods are largely based on visual monitoring performed by air traffic controllers, whereby, especially in adverse weather conditions, such as in fog, snowfall, or the like, the conditions may cause major setbacks and interruptions for air traffic. A principal reason for this is that it is not possible in all circumstances to visually make sure in a sufficiently reliable fashion e.g. the condition of a required runway door the equipment possibly present in such runway.

Therefore, e.g. after a snowplowing operation, it is generally necessary to wait at least an hour before it is possible to re-commission a runway to its primary applications. Snowy conditions are particularly inconvenient for traditional air traffic control methods since, as a result of sufficiently long runway standstill required as a safety precaution, there is time for fresh snow to gather thereon prior to the next commissioning of the runway, and this necessitates another pawing operation very shortly, leading to a continuing delay in air traffic as snowfall continues.

In addition, the traditional control system is not capable of controlling and guiding e.g. a landed aircraft to a terminal best suited for a given situation but, in principle, it is necessary to always stick with operating plans decided a long time before. Thus, e.g. occasional malfunctions, equipment breakdowns etc. often cause lengthy downtimes, resulting in a confusion in terms of preplanned timetables and arrangements. Furthermore, so-called "last-minute tune-ups" in traditional inflexible control systems frequently cause danger situations since, with manual arrangements, it is not possible to account for a sufficient number of factors even in minor changes of operating plan.

The prior art is described in US Patent 4,827,418, relating to an expert system which relies on so-called artificially intelligence based data processing for controlling the altitude and heading of especially airborne aircraft in order to avoid collisions. Such solutions make use particularly of LISP-programming or the like which, however, from the viewpoint of a person skilled in the art, does not have any significant equivalence to the processing solutions of the present invention. Thus, the system disclosed in

the cited patent is indeed primarily intended for air traffic control, which can also be used as an air control simulator. Moreover, in the cited solution, e.g. the positioning is carried out conventionally by means of a radar. It should further be noted that the mere LISP-programming represents quite traditional processing in terms of technology and, hence, the (at present virtually "out-of-use") LISP-programming is not even close to being sufficiently powerful in terms of solving problems equivalent to those addressed by the present invention.

On the other hand, unlike both the above-cited and the present invention, the reference publication EP 613,109 encompasses infrared-radiation based transmitters and receivers for the identification and positioning of aircraft in a ground traffic area. In the cited solution, the positioning is largely based on monitoring the field temperature levels, whereby sensors mounted on the field detect a new aircraft on the basis of an increase in temperature. Thereafter, the heading of this particular aircraft is determined as soon as some other heat identification unit has detected the elevated temperature caused by this aeroplane. Then, it is possible to determine mathematically the heading/acceleration/speed etc. of the aircraft, e.g. by the application of vector mathematics or the like.

From the viewpoint of a person skilled in the art, the cited solution is also essentially different from the present invention since, first of all, it is based on IR radiation. On the other hand, the positioning of aircraft as well represents quite traditional technology, especially in light of the present invention, nor does it function with reliability that would be even nearly equal to that of the present invention. Neither is the cited type of arrangement by

any means such that it could be utilised, at least not with a sufficient reliability, for monitoring the movements of persons/groups of persons working within a ground traffic area.

Thus, the cited solution is only capable of performing a fraction of what can be done with the present invention. Moreover, especially the use of IR radiation in this connection is unfavourable particularly for the following reasons:

- restricted in terms of its range/power
- necessitates a physical contact
- a limited number of channels
- out-of-date technology
- few practical applications, and even those in not absolutely crucial circumstances.

Hence, what the cited solution has in common with the present invention is primarily that it is intended for monitoring the position of aircraft or the like currently within a ground traffic area for avoiding collisions or the like by means of computer-assisted processing.

An object of a method of the invention is to provide a decisive improvement in terms of the above problems and hence to raise substantially the available prior art. In order to achieve this object, a method of the invention is principally characterized in that an expert system is informed about each unit on commission within an operative traffic area, preferably including also persons or groups of persons within the operative traffic area, by means of a radio-frequency operated transmitter system as well as by means of an antenna system enabling a substantially continuous-action positioning, the operative traffic being monitored and controlled by means of a comprehensive expert system, preferably making use of

so-called soft computing technology, such as a sum logic, a neural network, a neuro¬sum logic, chaos theory, genetic algorithms and/or the like for enabling its adaptive or self-learning operation.

The most important benefits gained by a method of the invention include simplicity, reliability in operation, and a remarkable improvement in the safety of operative traffic, the method making it possible to safely control for example all operative traffic associated with aviation while eliminating safety hazards and risk factors in the ground traffic within an airfield perimeter all the way from the landing of an aircraft to its take-off. A method of the invention also improves the speed and reliability of decision-making especially in abnormal situations, the method making it possible to eliminate unnecessary operation stoppages as well as congestions. Thus, a method of the invention provides a substantial improvement in the flexibility of especially ground and air traffic control, thereby producing a significant increase in the capacity of airfield traffic and in the economy of the entire airport operation. One further advantage gained especially by so¬called soft computing technology over the prior art-technology is that, first of all, e.g. the neuro-sum logic provides a system which is distinctly more inexpensive, speedier, and simpler than those described above and which requires significantly fewer rules. In addition, the deduction-making is significantly speedier, with possibly more than 1000-fold differences in favour of the presentinvention.

The non-independent claims directed to a method disclose preferred applications for a method of the invention.

The invention relates also to a control system operating in accordance with the method. The control system is defined in more detail in the preamble of an independent claim directed thereto. The principal characterizing features of the control system are set forth in the characterizing clause of the same claim.

When correctly implemented, the control system of the invention is trouble-free, operates in real time, and self-learning, in addition to which it can be coupled, e.g. in the afore-mentioned aviation, e.g. interactively with ground radar, surveillance, or e.g. meteorological systems or the like. Since it is also possible to connect the operative staff to an integral, intelligent coding and information system, controlled by an expert system and further secured preferably with arrangements based e.g. on biothermal identification for preventing e.g. the passage of unauthorized persons within operative areas, the control system of the invention is capable of providing a significant improvement especially in terms of the safety and efficiency of aviation by eliminating major safety hazards and risk factors associated with traditional aviation. Thus, the control system of the invention can be used for controlling all activities within the operative ground traffic area of an airport from the moment an aircraft has touched down on runway all the way to the moment said aircraft has safely taxied to its designated terminal lot or vice versa.

The non-independent claims directed to a control system disclose preferred embodiments for a control system of the invention. The invention will now be described in detail with reference made to the accompanying drawings, in which

fig. 1 shows basically a general operating principle for a control system applying a method of the invention,

fig. 2 shows further a method of the invention, applying a so-called diffuse spectrum-radio positioning system based on GSM-technology.

A method for operative traffic, said operative traffic, especially operative ground traffic associated with air traffic, being controlled by means of a real-time, automated data processing system, at least some of the operative units present in an operative traffic area, such as aircraft, field, maintenance, and upkeep equipment, vehicles or the like, being at least in an information transmitting communication therewith at least for the identification and positioning of the latter. An expert system 1 is informed about each unit on commission within an operative traffic area, preferably including also persons or groups of persons within the operative traffic area, by means of a radio-frequency operated transmitter system 2 as well as by means of an antenna system 3 enabling a substantially continuous-action positioning, the operative traffic being monitored and controlled by means of a comprehensive expert system 1, preferably making use of so-called soft computing technology, such as a sum logic, a neural network, a neuro-sum logic, chaos theory, genetic algorithms and/or the like for enabling its adaptive or self-learning operation.

In one preferred application of a method of the invention, the expert system 1 is supplied not only with collected real-time information i1, such as that regarding said operative units, but also with information i2 regarding the conditions of an

operative traffic area, such as wind, ice, snow, water, temperature and/or the like factors, for anticipating hazardous situations, such as collision situations or the like, by means of operating models db pre-programmed therein.

In reference to traditional solutions, it is naturally preferable to control operative traffic also by means of guide boards, one preferred application of a method of the invention comprising the use of luminous, such as optical fiber, LCD-, LED-matrix displays 4 and/or the like, which are controlled integrally by means of the expert system 1 especially for providing an active guidance optimally compatible with the situation of each controlled unit.

In a further preferred application of the method, each unit present in an operative traffic area is identified and/or positioned by means of a unit-specific and/or personal detector system 5, such as through the intermediary of remote identification and/or preferably the antenna system 3 or, respectively, by means of a transponder system (TIRIS) enabling the positioning, a fingertip, eyeground identification system and/or the like, based on biometric identification, especially for making use of unit-specific clearances, restrictions, priorities and/or the like programmed in the expert system 1.

In a particularly preferred application of the method, each unit present in an operative traffic area is identified and positioned most preferably by means of a cellular network principle, such as a mobile communicator system included in a mobile communication network consisting of cells containing a base station, the positioning being effected by using a diffuse spectrum-radio positioning system 2, 3, 5 based on so-called GSM-technology. Fig. 2 illustrates one

particular lay-out example for setting up the afore-mentioned diffuse spectrum-radio positioning system. 3', 5' represents in fig. 2 a taxiway shoulder light and a positioning beacon connected therewith. Respectively, 3", 5" represents a runway shoulder light and a positioning beacon connected therewith. kx represents a runway mid-line light. In a type of solution depicted in the figure, each moving/stationary object, or in this example an aircraft fp, fitted with a diffuse-spectrum transmitter 2' emitting an identification code. At this juncture, the runway shoulder lights present in the runway area and the taxiway shoulder lights receive and identify various diffuse-spectral transmissions, operating in accordance with the above-described logic as so-called positioning beacons. In this context, the radio path is provided by a system 2400 - 2450 GHz operating on ISM (Industrial & Scientifical & Medical) frequencies, having a frequency band of 50 MHz and a transmission capacity of < 10 mW. In this type of solution, at the object speed of 0 - 100 m/s, the coordinates are obtained at the accuracy of 0,1 - 10 meters. The scope of surveillance provides a possibility of monitoring all aircraft, vehicles moving in the area, maintenance people walking within the field area etc. In addition, the number of objects within the operating range of a single positioning analyzer may always be as high as 15 objects, whose activated identifications are included in the system data base.

For example, the above-mentioned TIRIS-system is based on an identifier (transponder), which is identifiable and preferably also attachable to an object to be positioned, and on a reader, which in this case is arranged in communication with the position-defining antenna system 2. In terms of technology, the TIRIS-system is constructed in such a way that the

identifier is provided with an antenna element, a micro-circuit containing an identification code, and a capacitor. When subjected to a magnetic field from the reader, the passive identifier is charged and transmits the message contained in the identifier. The identifications are either previously encoded or to be updated in the field of a reader. The identifier receives its necessary operating energy preferably from an electromagnetic field (radio waves) and, thus, it needs no battery or other source of energy.

Referring particularly to the preferred operating principle depicted in the drawing, the control system of the invention comprises a transmitter system 2, operating on radio frequencies and informing an expert system 1 about each unit operating within an operative traffic area, including preferably also persons and groups of persons present in the operative traffic area, as well as an antenna system 3 enabling a substantially continuous-action positioning, the surveillance and control of operative traffic in the control system being effected by means of the expert system 1, making use of so-called soft computing technology, such as a sum logic, a neural network, a neuro-sum logic, a chaos theory, genetic algorithms and/or the like, enabling its adaptive or self-learning operation.

The control system is further preferably based on a self-learning expert system 1, whose information and control channels are preferably constituted by apparatus-specifically encoded high-frequency transmitters 2, and further on an antenna system 3, required for positioning and detecting a set of coordinates to be positioned, and on an active and luminous display board arrangement 4, controlling an operative field area preferably through the intermediary of a so-called intelligent optical

network and based e.g. on an optical fiber/LCD-, LED-matrix.

In a further preferred application, the operative units/persons are linked to the system also by means of a unit-specific/personal detector system 5, such as a transponder system (TIRIS) enabling remote identification and the positioning preferably through the intermediary of the antenna system 3, a fingertip, eyeground identification system based on biometric identification, and/or the like. This enables making use of unit-specific clearances, restrictions, priorities and/or the like programmed especially in the expert system 1.

In a preferred application, the control system includes a diffuse spectrum-radio positioning system 2,3,5, which is preferably based on GSM-technology and whereby each unit present in an operative traffic area is identified and positioned preferably on a cellular network principle, such as a mobile communicator system included in a mobile communicator network consisting of cells that contain a base station.

In an intended application as described above, the control system monitors and controls automatically as well as transmits information independently about all operative traffic action within a field area and, by virtue of this, provides air traffic control and aviators with significantly improved possibilities of taking correct decisions and measures required by a given situation. In addition, the above type of control system increases substantially the capacity of operative field action (landing, take-off, surface traffic, flight maintenance) especially in foul weather conditions, as it is capable of composing an overall picture of all surveillance and sensor points simultaneously. The accuracy is further enhanced, as

the control system is capable of determining and deciding continuously and in real-time all situations and by constantly simulating both mathematically and empirically such situations before they are likely to occur. Thus, an expert system included in the control system is capable of identifying also completely unpredictable events e.g. by alarming the operative staff automatically and by describing the problem as well as by also presenting preferably e.g. graphic and safe, i.e. previously simulated and tested model solutions.

One further advantage offered by the control system of the invention in this context is that it relieves the air traffic control of all control measures regarding aircraft present on the ground and in a normal condition as well as other surface traffic. Hence, the control system concentrates the decision-making especially in a crisis situation on the air traffic control, the expert system, as well as on other monitoring systems associated preferably interactively with the control system, e.g. as depicted in the chart of the drawing. Hence, an expert system of the invention operates as part of the control system by delivering continuous, real-time, graphic information, solution models and suggestions, while leaving, whenever necessary, the actual decision-making to the air traffic control. According to the chart depicted in the drawing, the control system thus collects the real-time information, compares it to a safe decision compatible with the condition of the expert system 1, and produces an alarm about immediate or anticipated discrepancies. The analyzed surveillance information is stored automatically in the data base db.

In certain type of cases, the expert system 1 included in the control system operates automatically by deciding and performing all conventional and non-

hazardous control duties. In addition, it is possible to monitor thereby that the air traffic control performs correctly the ground traffic control operations assigned thereto.

The method and control system of the invention can be further exploited in such a manner that all relevant travelling paths within an operative area are also provided with guiding tapes or the like, controlled in real time by the expert system, whereby e.g. an advancing light or sound effect is used to guide each controlled unit to its proper destination.

It is naturally obvious that a method of the invention can be applied not only in the above-mentioned and -described applications but in the most diverse of contexts, i.e. in addition to ground traffic application, e.g. in a harbour area for controlling and monitoring the passage of boats/ships. Naturally, the operating chart depicted by way of example only represents generally the operating principle for a method of the invention, as it is of course possible to link directly therewith, in addition to the above-mentioned supplementary functions, e.g. an air traffic control radar and monitor info, air traffic control preference decisions, weather observations, etc. Also naturally, e.g. the above-described TIRIS-system can be active as well, whereby, when fitted with a current supply, it will be capable of independently communicating with the expert system, e.g. for the continuous positioning of a moving vehicle.

Claims:

1. A method for operative traffic, said operative traffic, especially operative ground traffic associated with air traffic, being controlled by means of a real-time and automated data processing unit, at least some of the operative units, such as aircraft, field, maintenance, and upkeep equipment, vehicles or the like, present in an operative traffic area, being at least in an information transmitting communication therewith at least for the identification and positioning of the latter, characterized in that an expert system (1) is informed about each unit on commission within an operative traffic area, preferably including also persons or groups of persons within the operative traffic area, by means of a radio-frequency operated transmitter system (2) as well as by means of an antenna system (3) enabling a substantially continuous-action positioning, the operative traffic being monitored and controlled by means of the comprehensive expert system (1), preferably making use of so-called soft computing technology, such as a sum logic, a neural network, a neuro-sum logic, chaos theory, genetic algorithms and/or the like for enabling its adaptive or self-learning operation.

2. A method as set forth in claim 1, characterized in, that the expert system (1) is supplied not only with collected real-time information (i1), such as that regarding said operative units, but also with information (i2) regardin the conditions of an operative traffic area, such as wind, ice, snow, water, temperature and/or the like factors, for anticipating hazardous situations, such as collision situations or the like, by means of operating models (db) pre-programmed therein.

3. A method as set forth in claim 1 or 2, wherein the operative traffic is controlled by means of guide boards present at least in an operative traffic area, characterized in that said guidance is effected by using luminous, such as optical fiber, LCD-, LED-matrix displays (4) and/or the like, which are controlled integrally by means of the expert system (1) especially for providing an active guidance optimally compatible with the situation of each controlled unit.

4. A method as set forth in any of the preceding claims 1-3, characterized in that each unit present in an operative traffic area is identified and/or positioned by means of a unit-specific and/or personal detector system (5), such as through the intermediary of remote identification and/or preferably the antenna system (3) or, respectively, by means of a transponder system (TIRIS) enabling the positioning, a fingertip, eyeground identification system and/or the like, based on biometric identification, especially for making use of unit-specific clearances, restrictions, priorities and/or the like programmed in the expert system (1).

5. A method as set forth in any of the preceding claims 1-4, characterized in that each unit present in an operative traffic area is identified and positioned most preferably by means of a cellular network principle, such as a mobile communicator system included in a mobile communication network consisting of cells containing a base station, the positioning being effected by using a diffuse spectrum-radio positioning system (2,3,5), most preferably based on GSM-technology.

6. A control system for operative traffic, said control system intended for controlling operative traffic, especially operative ground traffic

associated with air traffic, being implemented by means of a real-time and automated data processing unit, at least some of the operative units, such as aircraft, field, maintenance, and upkeep equipment, vehicles or the like, present in an operative traffic area being at least in an information transmitting communication therewith at least for the identification and positioning of the latter, characterized in that the control system comprises a transmitter system (2), operating on radio frequencies and informing an expert system (1) about each unit operating within an operative traffic area, including preferably also persons and groups of persons present in the operative traffic area, as well as an antenna system (3) enabling a substantially continuous-action positioning, the surveillance and control of operative traffic in the control system being effected by means of the expert system (1), making use of so-called soft computing technology, such as a sum logic, a neural network, a neuro-sum logic, a chaos theory, genetic algorithms and/or the like, enabling its adaptive or self-learning operation.

7. A control system as set forth in claim 6, characterized in that the expert system (1) is adapted to process not only real-time information (i1) collected therein and regarding said operative units, but also information (i2) regarding the conditions of an operative traffic area, such as wind, ice, snow, water, temperature and/or the like factors, for anticipating hazardous situations, such as collision situations or the like, by means of operating models (db) pre-programmed therein.

8. A control system as set forth in claim 6 or 7, including guide boards present at least in an operative traffic area for guiding said operative traffic, characterized in that said guidance is

provided by means of luminous, such as optical fiber, LCD-, LED-matrix displays (4) and/or the like, which are adapted to be integrally controlled by means of the expert system (1) especially for providing an active guidance optimally compatible with the situation of each controlled unit.

9. A control system as set forth in any of the preceding claims 6-8, characterized in that, for identifying and/or positioning each unit present in an operative traffic area, said control system includes a unit-specific and/or personal detector system (5), such as a transponder system (TIRIS) enabling the positioning through the intermediary of remote identification and/or preferably the antenna system (3) or, respectively, a fingertip, eyeground identification system and/or the like, based on biometric identification, especially for making use of unit-specific clearances, restrictions, priorities and/or the like programmed in the expert system (1).

10. A control system as set forth in any of the preceding claims 6-9, characterized in that it includes a diffuse spectrum-radio positioning system (2,3,5), most preferably based on GSM-technology, for identifying and positioning each unit present in an operative traffic area most preferably on a cellular network principle, such as by means of a mobile communicator system included in a mobile communication network consisting of cells containing a base station.

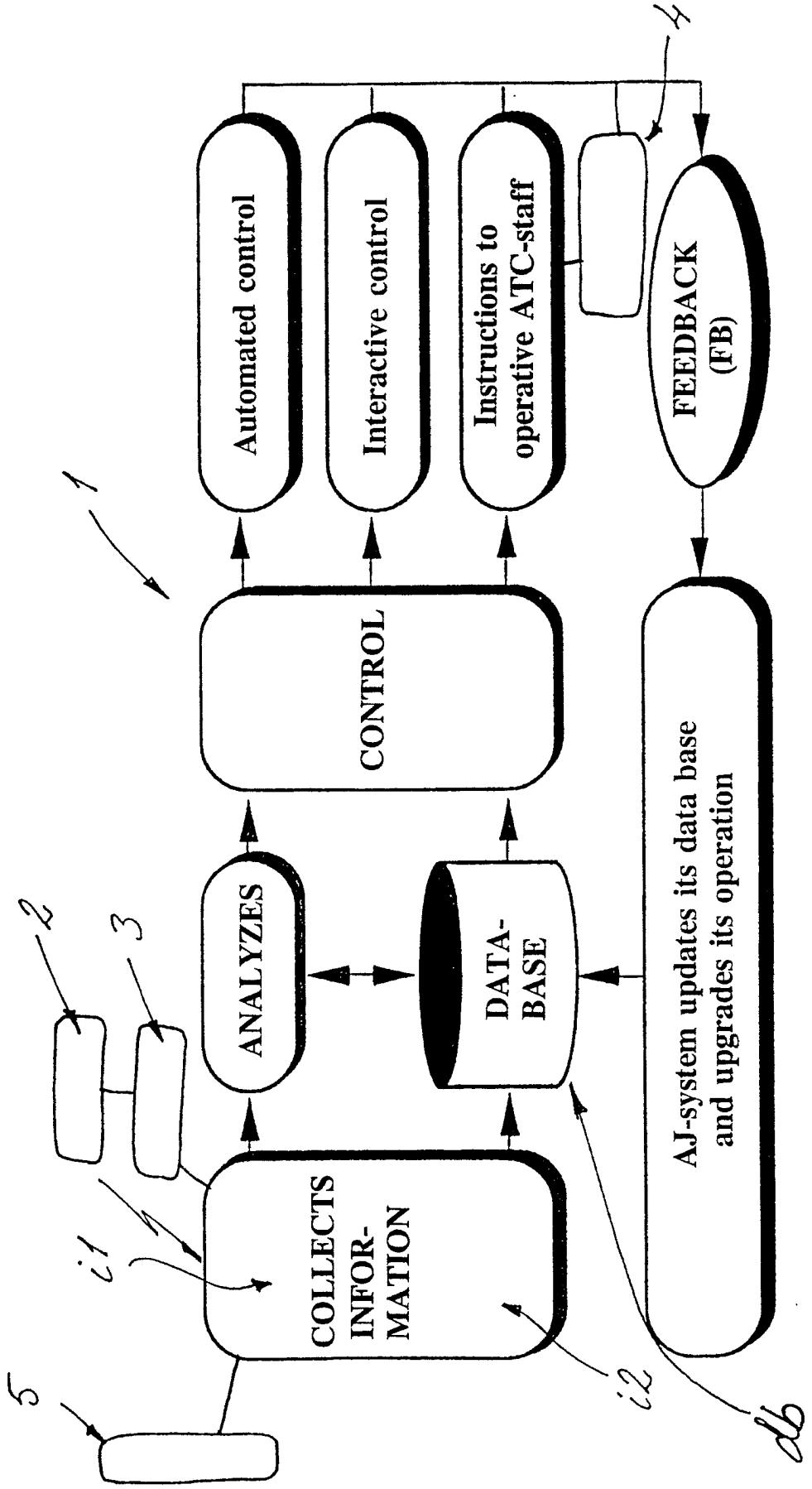
Automated control
Interactive control
Instructions to operative ATC-staff
FEEDBACK (FB)
CONTROL
ANALYZES
DATA-BASE
COLLECTS INFOR-MATION
AJ-system updates its data base and upgrades its operation
1
2
3
4
5
i1
i2
db

FIG. 1

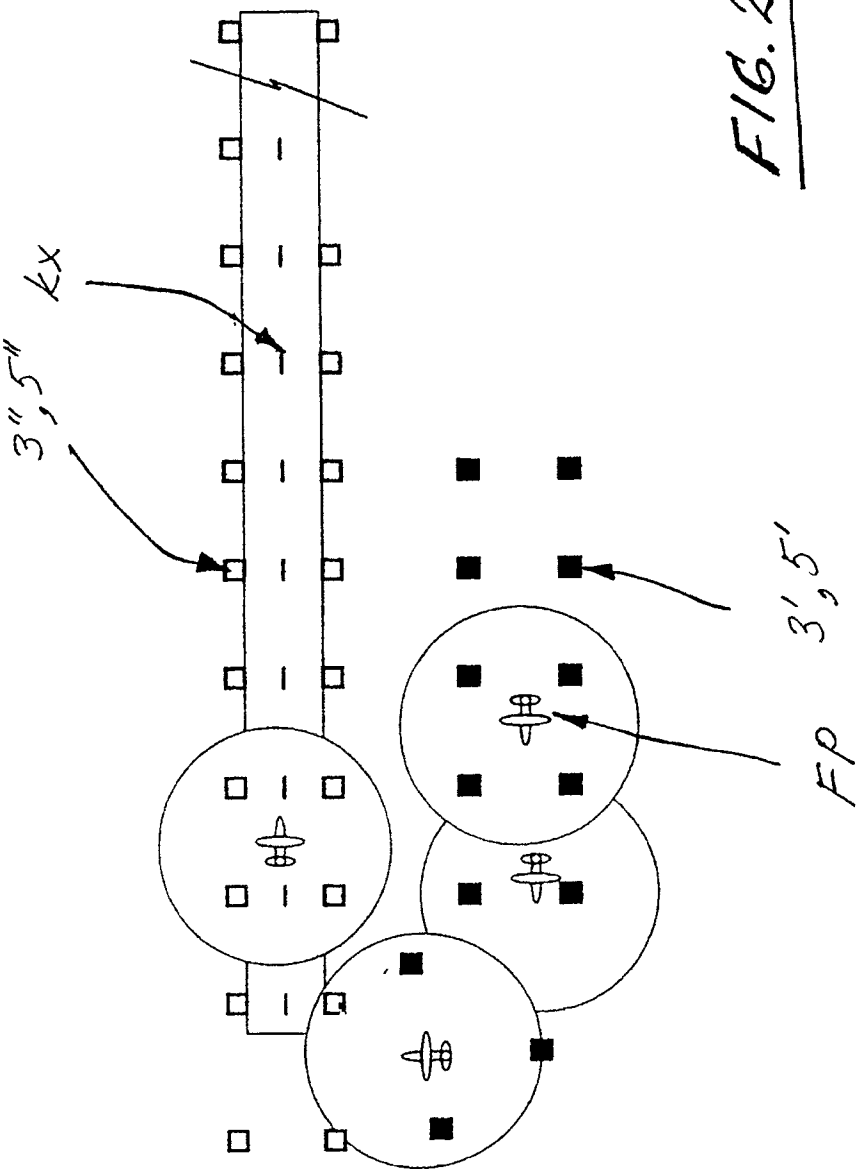

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00281

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G08G 5/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Electrical Communication, Volume, January 1993, Monzel F.-G. et al, "Surface Movement Guidance and Control System", page 51 - page 59, see the whole document --	1-10
A	US 4827418 A (ARTHUR GERSTENFELD), 2 May 1989 (02.05.89), abstract --	1,6
A	EP 0613109 A1 (RAYTHEON COMPANY), 31 August 1994 (31.08.94) -- --------	4,9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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13 February 1998	16 -02- 1998
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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/02/98

International application No.
PCT/FI 97/00281

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4827418 A	02/05/89	US 4949267 A	14/08/90
		US 4979137 A	18/12/90
		US 5200901 A	06/04/93
EP 0613109 A1	31/08/94	CA 2114482 A	27/08/94
		JP 6301899 A	28/10/94
		NO 940626 A	29/08/94